edexcel

Examiners' Report

Summer 2015

Pearson Edexcel International Advanced Level in Further Pure Mathematics F1 (WFM01/01)

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2015
Publications Code IA041572

Mathematics Unit Further Pure Mathematics 1

Specification WFM01/01

General introduction

This paper proved a good test of students' knowledge and students' understanding of F1 material. There were plenty of easily accessible marks available for students who were competent in topics such as series, matrices and transformations, numerical methods, complex numbers and coordinate geometry. Therefore, a typical E grade student had enough opportunity to gain marks across the majority of questions. At the other end of the scale, there was sufficient material, particularly in later questions to stretch and challenge the most able students.

The examiners did comment on how the standard of work was variable at times. Many students did appear well prepared and could demonstrate their knowledge and understanding but other students seemed largely unprepared for the paper and struggled even with the more accessible questions. There were a significant number of cases where questions were not attempted at all.

Report on Individual Questions

Question 1

This question proved accessible for the vast majority of students, with a high proportion scoring full marks. In part (a), the majority of students opted for long division to find the quadratic factor although many students expanded the right hand side of the given identity and compared coefficients.

In part (b), most students wrote down the real root and either used the quadratic formula or completed the square to find the other roots. Some careless errors were seen in the use of the quadratic formula, the most common of which was probably the loss of the square root sign so that $\frac{1 \pm \sqrt{1-4\times1\times2}}{2}$ became $\frac{1\pm7\mathrm{i}}{2}$.

Question 2

This question was answered well. The majority of students expanded $(3r-2)^2$ correctly although $(3r)^2 = 3r^2$ was seen very occasionally. Students almost always used the correct formulae for $\sum r^2$ and $\sum r$ and it was pleasing to see $\sum 4$ evaluated as $4n$ rather than 4 in the majority of cases. Most then took out a factor of n/3 or n/6 in order to achieve the required result although some expanded completely to obtain a cubic before attempting a factor. The most common errors resulted from taking out the factor of n/3 or n/6 and not compensating for the 1/3 or the 1/6 on all the terms inside the bracket.

Question 3

In part (a), the majority of students could write down the sum and product of the roots of the given quadratic and then use the correct identity to establish a value for $\alpha^2 + \beta^2$. Some students still insist on finding the individual roots explicitly which can unnecessarily introduce errors when establishing the value of $\alpha^2 + \beta^2$.

In part (b), the new sum and product were often calculated correctly but the main source of error was in forming the new quadratic equation. Such errors included; the omission of " = 0", not giving integer coefficients and the omission of "x" in the middle term i.e. giving the answer as $8x^2 - 33 + 8 = 0$.

Question 4

There was very much a mixed response to this question. The majority of students wrote down $PQ = 13$ in part (a) but for some students, this was the only mark they scored in this question. In part (b), those who knew the position of the directrix could easily establish the value of a, whilst many students used Pythagoras and the coordinates of P to form a quadratic in a. The most common approach in part (c) was to find the y-coordinate of P and use ½ base x height. Some students applied the 'shoelace' method using the coordinates of P, S and Q and were usually successful in finding the area required.

Question 5

The 7 marks in this question were generally very accessible to those students familiar with the numerical methods being tested. In part (a) there were many completely correct solutions but a significant number of students were clearly working in degrees which effectively restricted them to 1 mark in this part. Of those who proceeded correctly, it was surprising to see solutions that had missing or incomplete conclusions for the interval requested.

In part (b), students were often familiar with the process of linear interpolation and could obtain the required answer with ease. Some students erroneously used negative values for lengths and there were also some cases where students had one of their fractions the wrong way up. Those students who used a sketch to help them visualise the triangles, rarely made errors. Examiners commented that a significant number of students appeared to have memorised a formula that gave the required value directly.

Question 6

In part (a), the majority of students obtained a correct expression for the gradient of PQ and substituted into $y - y_1 = m(x - x_1)$. Those students who did not simplify the gradient to $-\frac{1}{pq}$ first, then sometimes struggled with the algebra required and, because of errors, were unable to obtain the printed answer. A small number of students used $y = mx + c$ as their straight line method.

Part (b) discriminated well. Many students could obtain correct gradient for the tangent and implicit, parametric and direct integration were all seen with approximately equal regularity. Many also then used the perpendicular gradient rule correctly to obtain the gradient of the normal at R. Many did then not know how to proceed and just found the equation of the normal or simply stopped. Those who did make further progress, could find the gradients of PR and QR although sometimes the work from (a) was repeated. It was rare to see a completely correct solution to part (b) and even those students who had completed all the necessary steps to establish the result, sometimes failed to give a suitable conclusion.

Question 7

In part (a), the modulus was usually found successfully although the frequency with which the statement, $\sqrt{9k^2 + 4k^2} = 3k + 2k = 5k$ was seen, was very surprising. Most students could make some progress towards finding the argument but there were a significant number of cases where the angle was incorrect. Students are advised to draw a diagram so they can visualise the argument. Some students used $\tan\left(\frac{2}{3}\right)$ rather than $\arctan\left(\frac{2}{3}\right)$.

There were many fully correct attempts at (b)(i) although some students attempted $\frac{4}{z+3k} \times \frac{z-3k}{z-3k}$ and made no progress. In (b)(ii), there were frequent errors when expanding $(-3k - 2k\text{i})^2$. These were mainly sign errors but also k^2 often appeared as k particularly with the term in i.

Students could recover marks in part (c) despite earlier errors and Argand Diagrams were often carefully drawn and points were labelled appropriately.

Question 8

Part (a) was well done and the only errors of significant frequency were with the calculation of the determinant or with attempts to simplify having previously found a correct inverse. In part (b), most students could proceed by using their inverse from part (a) but there were frequent errors in the matrix multiplication and the answers were not always given as coordinates.

In part (c), various methods were employed for finding the area of triangle T_2. The most efficient was to find the area of triangle T_1 and multiply by the determinant from part (a). It was probably the case that some students were unaware of this property of the determinant and chose to find the area of T_2 directly, using the 'shoelace' method or by finding the area of an enclosing rectangle and subtracting the areas of the surrounding triangles. The shoelace method was by far the more successful of the two methods.
Many students appeared to be confused by part (d) and did not know how to find the matrix **Q**. Relatively few students could find the correct matrix.

The order of multiplication of matrices for part (e) was well known and those who did obtain a matrix in part (d) could at least gain a method mark here.

Question 9

In many respects this proved to be the most challenging question on the paper, with part (ii) generally more successfully attempted than part (i).

In part (i), most students applied the first steps of the method of induction, evaluating the basic case with $n = 1$, assuming the statement was true for $n = k$ and attempting to add the $(k + 1)^{th}$ term. Most students who got this far went on to show that the statement was true for $n = k + 1$, although errors were seen at this stage and some students jumped straight to the expected answer with no supporting evidence. Where students had successfully applied the method of induction, their conclusion was sometimes missing one or more element (often "true for $n = 1$") and the final accuracy mark was lost. A small number of students completely ignored "Proof by Induction" and used the standard formulae instead, attempting to expand the LHS and/or RHS and perform various algebraic manipulations.

In part (ii) correct starts were made by establishing that $n = 1$ gave the same matrix. Most then attempted an appropriate matrix multiplication although some errors were seen in the resulting algebra. A surprising number of students attempted to add the two matrices rather than multiply them. As in part (i), the conclusions were sometimes incomplete or unclear. In some cases students' concluding statements suggest that the principle of mathematical induction is not really understood. There were also some minimalist conclusions where, after correct working, the student simply wrote "so true for all n".

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom